SCIENCE REVIEW OF AN ENVIRONMENTAL EFFECTS AND SURFACE WATER COMPLIANCE MONITORING REPORT FOR SYDNEY HARBOUR, NOVA SCOTIA

Context

In January, 2010, the Environmental Assessment and Major Projects (EAMP) division of the Oceans, Habitat, and Species at Risk Branch in the Maritimes Region requested that DFO Maritimes Science undertake a review of a document entitled "Environmental Effects and Surface Water Compliance Monitoring Preconstruction/Baseline Report." EAMP requested DFO Science advice on the report related to the following issue:

i) Is the design of the environmental effects monitoring (EEM) program effective in determining any potential negative environment effects from the Sydney Tar Ponds and Coke Ovens Sites Remediation Project?

This information will be used to refine the EEM program and/or adjust mitigation measures to ensure environmental protection objectives are met. It was requested that a response be provided within a few weeks. Given the short timeframe for review, DFO's Science Special Response Process was used.

Background

On October 1, 2007, after a panel review under the Canadian Environmental Assessment Act (CEAA) the Government of Canada permitted the Sydney Tar Ponds and Coke Ovens Sites Remediation Project to proceed. Recommendation 19 of the Panel Report stated, "The Panel recommends that PWGSC, in consultation with NRCan, DFO, Environment Canada, and STPA, design a long-term monitoring program to document improvements in the environmental quality of Sydney Harbour. DFO should assume the lead for long-term monitoring." As stated in the Government of Canada response to the Panel Report, DFO would not assume the lead but is a key player in the review of the EEM program.

In May 2004, a Memorandum of Agreement (MOA) jointly committed the Federal Government of Canada and the Province of Nova Scotia (NS) to remediate contaminated areas of the Muggah Creek Watershed. In 2008, the Sydney Tar Ponds Agency initiated an environmental effects monitoring (EEM) program for Sydney Harbour with the overall objective of measuring the preconstruction (baseline) conditions for the Watershed. The objective of the present baseline study is to document soil, water and sediment conditions prior to the implementation of major remedial works. The data provides reference points for comparison of subsequent monitoring results obtained during the construction and post construction phases of the project.

Response

The draft report was well written with an appropriate amount of reference to work previously done in the area. However, there are a number of aspects concerning sampling design, methods and results reporting that can be enhanced to ensure the objectives of the monitoring program are satisfied.

Marine Water Quality

Section 3.5.2.1: Water Grab Samples

It would be beneficial to use one composite sample to compare with samples taken over a tidal cycle to determine if a tidal signal exists. Within the present sampling strategy, it is not possible to determine which of the composite 400 ml samples contain higher values for the measured parameters, including general chemistry, select metals, total suspended solids (TSS), total organic carbon (TOC), polycyclic aromatic hydrocarbons (PAHs) and Aroclor polychlorinated biphenyls (PCBs).

Sediment Composition and Quality

Section 3.5.3.1: Grab Samples

This section is well written with attention to detail. The flocculent layer transports surface reactive contaminants and would reveal the most recent changes in sediment contaminant concentrations. While care was demonstrated during sampling, it should be noted that the use of grab samplers may disrupt the flocculent surface fluff layer, which may, therefore, go unsampled.

Section 3.5.3.3: Toxicity Tests

To reduce variation among sites, it is recommended that sediment from control sites be of similar grain size to the samples collected in the south arm of Sydney Harbour.

Benthic Community Assessment (Methods)

Section 3.5.6.1: Assessment of Benthic Sub-tidal Communities

Subtidal benthic animals were collected in five individual grab samples at each monitoring station. Information concerning the distance between grab samples at each station, area and volume sampled and sediment depth penetrated by the grab sample is not provided.

Section 3.5.6.2: Assessment of Benthic Intertidal Rocky Shore Communities

The sampling protocol for the intertidal benthic communities is considered to be unlikely to fulfill the objectives of the benthic component of the monitoring program. Additional details and information are required, or the protocols may need to be modified.

There is a general lack of detailed information on the protocols provided in the report. The report indicates that 1) one transect was deployed at each of five stations and 2) one quadrat was deployed within each zone on the shore. Information regarding how the intertidal zones were determined and whether the intertidal zones were comparable among shores samples is lacking.

Sub-sampling smaller squares within each quadrat does not provide replicate data and it is unclear how the natural variation within each shore will be accounted for. The correct interpretation of any data obtained depends on the ability to replicate data and account for natural variation which would be achieved through the deployment of replicated quadrats. Many rocky intertidal studies in the literature recommend using 10-20 quadrats per intertidal zone,

depending on the degree of natural variability. The use of one quadrat per zone does not provide a basis for comparison among shores or even for the development of a robust baseline dataset.

Another major concern relates to the shorelines designated for sampling. The sediment type at each shore ranges from gravel, cobble/sand mix, bedrock slab, rock platform and boulder beach. It is not indicated if shore diversity will be compared. If so, any differences observed will be in part due to the vastly different sediment types. The shores chosen for sampling represent a nice gradient in distance from the remediation site, and could provide essential information on the distance effect if comparable shorelines are chosen for analyses.

The authors state that $1/2m^2$ quadrats were used which would correspond to quadrats measuring 0.71m x 0.71m. It is possible that the authors meant that 0.5m x 0.5m quadrats were used. If so, then the quadrat area is $0.25m^2$. Likewise, the authors indicated that each sub-square within the quadrat was $10cm^2$. It is possible the authors meant 10cm x 10cm. If so, the area of each subsquare is 100 cm^2. Providing correct dimensions is essential for appropriate data interpretation.

It was unclear whether mobile fauna, and epifauna and epiphytes on algae were sampled

It was unclear whether algae cover that occurred within the quadrat with the stipes located outside the quadrat were included within the analysis. If sampling convention was followed, these samples would not be included in the analysis.

It is unclear if the coding for enumerating animals is adequate for large populations of animals, such as barnacles. Categories (e.g., >100) are used to report the number of barnacles; however, it is unlikely that the current classification system would account for large populations that may be present within a quadrat. It would be helpful if the categories were extended to include barnacle counts greater than 500, 1000 and 10,000.

Benthic Community (Results)

4.4.5.2: Inter-tidal Rocky Shore Benthic Communities

There is a lack of data concerning the quantitative benthic community assessment referenced within the report. On page 110, the reader is referred to Appendix D for survey results and images; however, the data are not provided. It is essential that quantitative data be provided for full evaluation of the adequacy of the data for use as a baseline dataset and also the evaluation of the protocols. The qualitative description of data given for each transect, presumably from one quadrat per shore zone, is inadequate. A basic presentation of mean and some measure of variability among replicate samples is required to adequately describe the benthic community. The mean and standard deviation for animal species within each zone at each site, and mean percent cover of algae are some basic measures that are essential for comparison with data collected at future dates. A full species list should be provided in an appendix. The data, as provided, do not constitute a robust baseline dataset for future comparison.

There is a lack of detail concerning how the data will be analysed to fulfill the program objectives. The authors provide no information on the planned data analyses, other than parameters that will be calculated, nor provide data analyses of their collected data. The report should indicate if comparisons across the distance gradient from the remediation site will be undertaken, how the data will be analysed over time to provide information on the effects of the

remediation, how benthic data will be related to measured environmental variables and whether multivariate statistical analyses, such as multidimensional scaling (MDS), will be employed.

Review of Construction Monitoring and Recommendations

Section 6.3: Marine

The period of collection of the sediment traps should be lengthened or multiple traps be deployed in one location so pooling of sediment across stations does not occur. In addition, all marine sediment and water quality data should be compared to the Canadian Council for Ministers of the Environment (CCME) guidelines. At a minimum, a table containing CCME values for metals or a comparable table for metals, PAHs, and PCBs should be incorporated such that elevated values within the baseline study can be viewed as harmful or slightly elevated above background and flagged as a potential area of concern if necessary. Most of the values in Appendix D of the "Environmental Effects and Surface Water Compliance Monitoring Preconstruction/Baseline Report" are below CCME values.

Taxonomic Reporting

Within the report there are several mistakes concerning taxonomic identification.

(i) Limpets are not *Balanus balanoides*, as consistently indicated throughout the report. It is unclear if the authors are referring to barnacles or limpets.

(ii) *B. balanoides* is no longer taxonomically valid (www.itis.gov). It is unclear if the authors are referring to *Semibalanus balanoides*.

(iii) It is recommended that the number of algal species be identified as opposed to the repeated use of the terms "filamentous green algae" and "filamentous brown algae". Each species should be identified, as some algal species are more sensitive to environmental changes than others.

(iv) Gastropods are identified in all quadrats. Gastropods are fairly easy to identify and internal anatomy can be used as a pollution indicator.

(v) A "black encrusting algae" is referred to on Page 111. Is it possible that the authors are referring to a cyanobacteria film.

Conclusions

The draft report was well written with an appropriate amount of reference to work previously done in the area. Generally, the inclusion of benthic community sampling within the program is well identified and could provide important data that documents benthic community changes as remediation progresses. Likewise, the report does well to highlight sampling strategies and monitoring techniques pertaining to marine water and sediment, and it reports the results in a clear manner. However, several aspects of sampling design, methods and results reported should be addressed and improved to ensure the objectives for the benthic component can be satisfied. Currently, the benthic component of the report does not provide a robust baseline dataset or provide a means for future comparisons. Insertion of protocol information, quantitative benthic community data, and statistical analyses will enhance the report and also provide evidence that the program objectives will be met.

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